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Effectiveness and biochemical effects of neem against different species of grasshoppers (Orthoptera: Acrididae)

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Abstract:

Efficacy of neem was tested against 3rd, 4th and 5th nymphal instars of different species of grasshoppers at El-Baharia Oasis Western Desert of western Egypt by using micron Ulva sprayer (ULVA+). Mortality percentages were calculated after 2, 4, 6, 8, 10 and 12 days post treatment. The results showed that there is no mortality in the check (untreated after 2, 4, 6, 8, 10 and 12 days). Data cleared that the percentages of mortality of nymphal instars of grasshoppers were 10, 15, 25, 30, 65, 88 % after 2, 4, 6, 8, 10 and 12 days post treatment, respectively. The effect of neem on ALP, AST and ALT activity were tested. ALP activity showed that significant decreased between treatment insect, 5.09, 11.6 and 14.22(U) and control 12.9, 14.4 and 16.2 (U) after 2, 4 and 6 days posttreatment. AST activity was significant increased between treatment insects 68, 57 and 49 U/gm body weight and control 22, 28 and 34 U/gm body weight after 2, 4 and 6 days posttreatment. Also ALT activity was significant increased between treatment insects 73, 76 and 69 U/gm body weight and control 19, 26 and 37 U/gm body weight after 2, 4 and 6 days after treatment.The efficacy of neem in all treatments can be useful for development safe elements for an IPM strategy to grasshoppers.

Introduction

Locust and grasshoppers (Orthoptera: Acrididae) are considered one group of the serious agricultural pests that cause considerable damage to different crops and pasture grasses in Africa and Asia particularly during outbreaks (Showler, 1993). Several species of grasshoppers such as; *Euprepocnemis plorans plorans*, *Hetracris annulosa*, *Acrotylus insubricus*, *Chourotogonus homalodemis*, *Acrididella nasuta*, *Catantops axillaris* and *Aiolopus strepens* are considered among the most were found to attack the agricultural crops in Egypt and many parts of the world. Also, locust and grasshoppers generally have very high reproductive rates and are able to respond to unfavourable climatic conditions with rapid population increase (Bateman *et al*., 1993). Field trials showed the efficacy of some chemical insecticide formulations, the bioinsecticide *Metarhizium anisopliae* var. *acridum* and anti moulting agent Atabrone against different species of grasshoppers at El-Baharia Oasis, Western Desert of Egypt by micron Ulva sprayer (Ulva+) (Abdel-Fattah and Abdel-Lattef, 2013). The neem

tree (*Azadirchta indica* A. Juss), from the Meliaceae (mahogany) family, known as Indian lilac, has long been recognized for its properties both against insects and in improving health (Barrek *et al*., 2004). The effect of antifeedant (Neem) and IGRs (Cascade) and their mixture at different concentrations on nymphal instar of the desert locust, *Schistocerca gregaria* (Forskal) (Orthoptera: Acrididae) by feeding technique. The biochemical effects of neem and cascade on the mortality percentages, malformations and some biochemical changes were studied by Soltan (2014). Abdelbagi *et al*. (2019) investigated the potential of the systemic growth regulator effects of various neem seeds products against immature stages of desert locust infesting potted millet plants in Sudan. All neem seed product induced significant systemic antifeedant activity, ranging from 52 to 99% against the immature.

The present study aimed at studying the effect of neem against some different species of grasshoppers and some biochemical effects alkaline phosphatease (ALP), aspartate transferase (AST) and alanine transaminase (ALT) in the field at El-Baharia Oasis, Western Desert of Egypt.

Materials and methods

During the seasons 2017 and 2018 many ecological surveys were carried out to evaluate the major insect pests of family Acrididae prevailing at El-Baharia Oasis, Western Desert of Egypt. It was found that the grasshoppers, *E. plorans plorans, H. annulosa, A. insubricus, Ch. homalodemis, A. nasuta, C.* axillaris and *A. strepens* and the local locust *Anacredium aegyptium* were existed in this area. Among these pests, the berseem grasshopper, *H. annulosa* was the most dominat. A suitable infested area characterized by high population tested nymphs were 3^{rd}, 4^{th} and 5^{th} instars only.

1. **Chemical used (Neem):** Neem Force 0.15 % EC (Azaderachtin) ([22,23-3h_2] dihydroazadirachtin) at the rate 1 litre/ha.
2. **Experimental design:**

A field cultivated by alfalfa (*Medicago sativa*) in sandy loam soil, highly infested with different grasshoppers, mixed with few local locusts at the region of Western Desert El-Baharia Oasis was chosen in August 2019. The field was divided to plots of (35x20) = 700 m^2 each the plots were isolated by a wide belt of 10x25 = 250 m^2. Five plots were allocated randomly for each treatment. Plots laying up wind of treatment were used as a control. The untreated cheek plot was sprayed with water only. Each treatment as well as the control was represented by five replicates (cages) 0.5m x 0.5m. The cages were put in the treated plots. The insects were collected randomly from the same treatment of the pesticides after application directly by using sweep-net and introduced to the cages. The insects were kept in cages and fed with treated plants (alfalfa) from the same plot. Unfortunately, the sweeping net didn't catch any individual of locust after treatment, so, locust results were not mentioned in the tables, however, by observation after treatments, there was no alive individual. Mortality counts were calculated after 2, 4, 6, 8, 10 and 12 days posttreatment but collected haemolymph after 2, 4 and 6 days post treatment to biochemical analysis. A suitable infested area characterized by high population density of grasshoppers (more than 30 insects/m^2) was selected. The tested nymphs were 3^{rd}, 4^{th} and 5^{th} instars only (Abdel-Fattah *et al*., 2012).

- **Sprayer used:**The micron Ulva (ULVA+).
- **Nozzle:** Red nozzle to treatments EC. Red nozzle calibrated 90 ml water/min.
- **Spraying height:** 0.5 m above the plants.
- **Walking speed:** 40m/min = 2.4 km/hour.
- **Swath width:**3m according to wind velocity.
- **Weather conditions at applications:**

Wind: 4–6 m/sec, measured by anemometer.

Temperature: 33^oC ± 2 ^oC, the sun rose clearly.

The spraying was done between 07 and 10 am in morning.

Daily routine works includes removing the previous uneaten food, faeces and dead nymphs and counting the living insects before introducing the fresh food were conducted.

3. Collection of haemlymph: according to the technique was followed as described by Amin (1998).

4. Alkaline phosphatase determinations:

Alkaline phosphatase (ALP) was determined according to the method described by Powell and Smith (1954).

5. Transaminase determination:

Aspartate transferase (AST) and alanine transaminase (ALT) were determined colormetrically according to the method of Reitman and Frankle (1957).

Statistical analysis:

Data were analyzed using general linear model procedures (SAS, 1995).

Results and discussion

1. Effectiveness of neem against different species of grasshoppers *:*

The effect of neem was tested under field conditions against 3rd, 4th and 5th different nymphal instars of the grasshoppers by using ULVA+ spraying equipment after 2, 4, 6, 8, 10 and 12 days post- treatment. Data in Table (1) showed that the efficacy of neem against nymphal instars of grasshoppers after 2, 4, 6, 8, 10 and 12 days posttreatment. Results showed that there is no mortality in the check (untreated after the same intervals dates). Data cleared that the percentages of mortality of nymphal instars of grasshoppers were 10, 15, 25 ,30, 65 and 88% after 2, 4, 6, 8 , 10 and 12 days posttreatment, respectively. The present result in this concern agreed with (Abdelbagi *et al*., 2019; Schmutterer and Feres, 1990; Soltan, 2014 and Nicol and Schmutterer, 1991).

Table (1): Mortality percentage of neem against nymphal instars of the grasshoppers, after 2, 4, 6, 8, 10 and 12days post treatment in the field.

Days after treatment	Neemmortality %	Controlmortality %
2	10	0
4	15	0
6	25	0
8	30	0
10	65	0
12	88	0

2.Biochemical effects of neem on alkaline phosphatase (ALP) aspartate transferase (AST) and alanine transaminase (ALT)activity to nymphal instars grasshoppers:

Data in Table (2) showed that, the effects of neem on ALP, AST and ALT activity. Neem show significant decreased that ALP activity between treatment insect 5.09, 11.6 and 14.22(U) and control 12.9, 14.4 and 16.2 (U) after 2, 4 and 6 days after treatment. And AST activity was significant increased between treatment insects 68, 57 and 49 U/gm body weight and control 22, 28 and 34 U/gm body weight after 2, 4 and 6 days after Neem treatment. Also ALT activity was significant increased between treatment insects 73, 76 and 69 U/gm body weight and control 19, 26 and 37 U/gm body weight after 2, 4 and 6 days after Neem treatment. These results agree with those obtained by (Abdel-Aal, 2002; Assar *et al*., 2012; El-Sheikh, 2002 and Soltan, 2014).

Table (2): The effect of neem on alkaline phosphatase (ALP) (U), aspartate transferase (AST) and alanine transaminase (ALT) (U/gm body weight) activity of nymphal instars grasshoppers.

Days	ALP (U)		AST (U/gm body weight)		ALT (U/gm body weight)	
	Treatment insects	Control insects	Treatment insects	Control insects	Treatment insects	Control insects
2	5.09^{c}	12.9^{a}	68^{a}	22^{c}	73^{a}	19^{c}
4	11.6^{b}	14.4^{a}	57^{a}	28^{c}	76^{a}	26^{c}
6	14.22^{b}	16.2^{a}	49^{b}	34^{c}	69^{b}	37^{c}
LSD	9.6	7.83	47.2	38.5	35.6	29.1

F:Measurement of distance between individual distributions.
Means with the same letter are not significantly different.
Means with the different letter are significantly different and a=*, b=, c***.**

Acid and alkaline phosphatases have been shown to be associated with insect development, especially in relation to nutrition and egg maturation (Tsumuki and Kanehisa, 1984). Sridhara and Bahat (1963) stated that the increase of both phosphatase enzymes during development is reflected in increase or decrease in acid-soluble phosphorus content. Transamiase enzymes were considered as key enzymes in the formation of non essential amino acids, which is formed inside the body not taken outside in metabolism of nitrogen waste and gluconensis (Mordue and Goldworthy, 1973).Azmi *et al*. (1998) stated that the transaminases (ALT and AST) enzymes help in the production of energy and serve as a strategic link between the carbohydrates and protein metabolism and are known to be altered during various physiological and pathological conditions.The efficacy of neem in all treatments can be useful for development safe elements for an IPM strategy to grasshoppers.

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